Anonymous Referee #1

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… ….

Overall, I recommend publication of the manuscript by Hanson et al. after they have addressed the comments listed below.

Comments

(1) Section 2: Although the chemistry model is described in the earlier publication by Hanson et al. (2019) it would be good to add a paragraph, which summarizes the chemistry treated by the model.

We will add a few sentences and reference specific sections (2.1 and S7) and tables (S1) where details are presented in Hanson et al. 2019.

(2) It is mentioned that the binary nucleation experiments yield the lowest values reported so far. The authors should include a figure, where all their measurements (the earlier ones from 2019 and the current ones) are inter-compared with the results from other studies. Currently such a figure is only shown for the experiments with ammonia but not for the nominally binary system.

This figure is now included as Fig. 5b (see included figure) that illustrates well how the results from PhoFR have changed over the course of a few years. A new section '3.5 Nominal Binary Results, Then and Now' was formed from some of the previous text and a new paragraph describing Fig. 5b.

(3) In Figure 7 results from a nucleation and growth model are shown for different sets of thermodynamic data. This model is probably rather complex and therefore evaluation would be beneficial. Evaluation could be performed by using an identical set of thermodynamic data and compare the model output to another model. This could, e.g., be done for the ACDC (Atmospheric Cluster Dynamics Code) model together with the thermodynamic data for H2SO4-NH3 nucleation from Ortega et al. (2012). Results for these thermodynamic data using ACDC were presented by Kürten et al. (2016).

The verification that we presented in our SC comment we will work up as a section in the Supplement. The reviewer's comment helped us to see that we had not published such a verification step for the box model; we note that the 2D model had been compared to a commercial CFD result (S2.1.1 of Hanson et al. [2017]).

Further comments

L155 (page 5): Please specify why NO accelerates the H2SO4 production?

NO reacts with HO_2 that is generated in the OH + SO_2 +O_2 reaction. Will be parenthetically noted in the revised text.

L282 (page 9): Why was the CPC inlet exposed to room air?

To get a reference pulse height for large particles. Because of shifting baselines due to older electronics, we decided to not rely on pulse heights for sizing information. Nonetheless, we traced the main reason for changes in the UCPC vs. DEG system responses to a cylinder changeover.

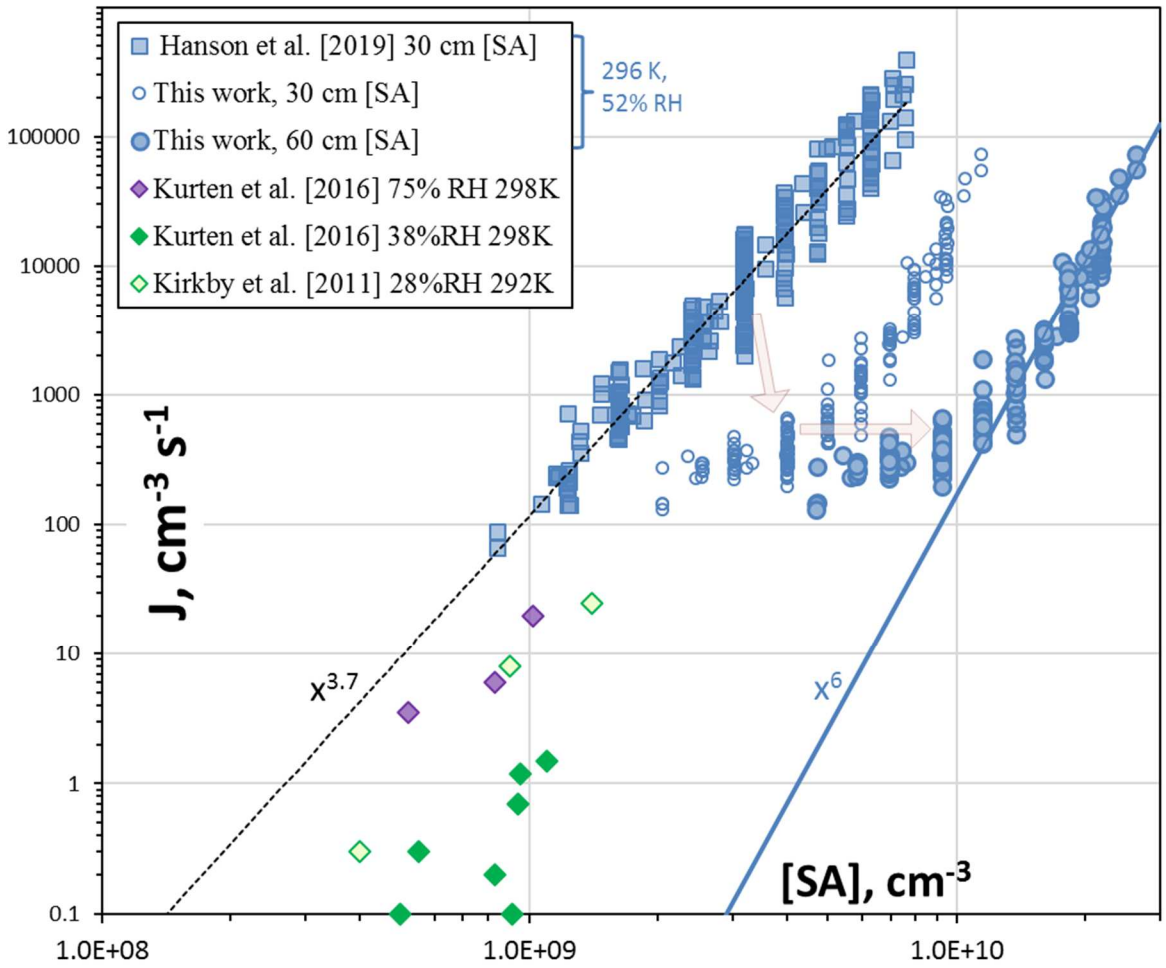

Fig. 5(b) Nucleation rate vs. H_2SO_4 (SA) concentration. For PhoFR data, nucleation rate given by N_p divided by an estimated 5 s nucleation time. The [SA] concentration was that calculated at 30 cm, both for the Hanson et al. [2019] data set and for this work (open circles). The filled circles are the nucleation rates for this work but plotted at the 60 cm calculated [SA] concentration. The red arrows show how the system has evolved for data taken at Q_4=4.25 sccm. Nucleation rates from the CLOUD experiment at 292 and 298 K for nominal binary conditions are also shown.